EVANS & SUTHERLAND COMPUTER CORPORATION

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August 9, 1973

Dr. Thomas G. Stockham
Computer Science Department
University of Utah
Salt Lake City, Utah 84112

Subject: Our proposal no. 73-08-01
To build and operate a real time shaded picture generating system

Dear Dr. Stockham:

Evans & Sutherland proposes to build and operate a real time shaded picture generating system in conjunction with the University of Utah.

The proposed system would provide a means by which the University of Utah can obtain a graphics facility which incorporates the best state-of-the-art techniques and which is suited to continued use as a research tool. Further, it would provide Evans & Sutherland access to a facility which it can use for its own research and other purposes including picture making.

Evans & Sutherland are the leaders in this technology and as such have delivered the only known commercial system to Case Western Reserve University.

It is suggested that a contract be awarded as quickly as possible to allow for early delivery and to permit the use of some presently available components such as a PDP-11/45.

Shipments will be as shown in the proposal under the sections Delivery Schedule and Payment Schedule.

We propose a fixed price contract. Prices for the Evans & Sutherland effort are as follows:

FY 74	$202,193
FY 75	55,337
Total Price	$257,530

Prices quoted are F.O.B. University of Utah and include installation, commercial documentation package, and warranty against defects in workmanship or material for 90 days from installation.

Terms are Net.

This quotation is valid until September 14, 1973.

Should there be any questions regarding this quotation, please do not hesitate to call or write the undersigned or Mr. Del Freeze.

Sincerely,

David C. Evans
President

DCE:cm

cc: Dr. William S. Partridge
Mr. Carl M. Ellison
Mr. Del Freeze
Dr. Ivan E. Sutherland

PROPOSAL TO THE

UNIVERSITY OF UTAH

TO BUILD AND OPERATE

A REAL TIME SHADED PICTURE GENERATING SYSTEM

PROPOSAL NO. 73-08-01

August 9, 1973

Evans & Sutherland Computer Corporation
Three Research Road
Salt Lake City, Utah 84112

SUMMARY

This is an unsolicited proposal by the Evans & Sutherland Computer Corporation to design, build, install and jointly operate a state-of-the-art computer image generation computing facility for the University of Utah.

There are two primary service objectives of the proposed facility:

1. To provide a means by which the University can obtain a graphics facility which incorporates the best state-of-the-art techniques and which is suited to continued use as a research tool.
2. To provide Evans & Sutherland access to a facility which it can use for its own research and other purposes including the establishment of a picture making service available to the government and industry.

BACKGROUND

The University of Utah, by virtue of its ARPA sponsored research, and the Evans & Sutherland Computer Corporation, which is located on the University of Utah campus, both have major investments in the development of the techniques, algorithms, software, and hardware for dynamic generation of shaded pictures of numerical models of illuminated objects. These two groups have recently been joined by other pioneers in the development of this computer graphic art: Martin Newell of Cambridge, England, who has been an important developer of the shaded picture art and who has made some of the finest pictures has joined the University; Rodney Rougelot, Robert Schumacker and Ed Wild who built the first dynamic shaded picture system while employed by the General Electric Company have joined Evans & Sutherland. As a result of this gathering together in Salt Lake City there is no group of people of comparable achievement in the field at any other location. By pooling the available human and financial resources of these two groups in a cooperative effort a superior facility can be implemented in a much shorter time than would be possible by either group alone.

The University of Utah group has research and development capabilities in algorithms and software systems, and has experience in the operation of multi-access computing systems. Evans & Sutherland have primary capability in systems engineering, the

design and fabrication of hardware systems and in the application of graphic systems to practical problems. Evans & Sutherland is the only company which has built and delivered such a computer graphics facility.

THE FACILITY

The proposed facility is a general purpose computing facility for the production of computer generated pictures. It operates under the control of a PDP-11 Model 45 computer which is an integral dedicated component of the system. The system has the capability to produce individual pictures and animated picture sequences based on structured numerical models of three-dimensional objects. The pictures may be monochrome or color. The system will include basic software to support the generation of numerical models and to make pictures. The University of Utah portion of the service of the system will be allocated as is determined by the University. The Evans & Sutherland portion of the facility will be available to Evans & Sutherland to use for its own purposes and to provide picture making service on a fee-for-service basis to those needing such service.

It is proposed that the facility be jointly financed by Evans & Sutherland and the University and located at the University of Utah in close proximity to the computer science research computing facilities and the University of Utah computer center

where a general purpose computing support is readily available. It is also proposed that the operating staff be University of Utah employees and that Evans & Sutherland be responsible for the system engineering, engineering design, fabrication, installation of the system and maintenance of the system for the duration of the contract.

Evans & Sutherland will provide technical assistance and picture making service for customers making use of either the Evans & Sutherland service portion or the University of Utah service portion of the facility. A separate rate structure will be established for the available services and for the use of the equipment. The Evans & Sutherland services will be available equally to private and government users independent of whether use is to be made of the University share or of the Evans & Sutherland share of the facility. As proposed the University would agree not to receive any remuneration for any technical assistance or use of the graphics facility which they may provide except that the University may provide photographic laboratory services for a fee. Evans & Sutherland will not only provide the documentation and technical assistance that will permit competent computer personnel to make use of the picture making facility but will actively seek users for these services so that a variety of users will become acquainted with the capabilities of state-of-the-art computer graphic systems.

Access to the facility should be on a 24-hour daily basis with access to Evans & Sutherland and the University in proportion to their relative contributions to the value of the facility based on the market price of the equipment and the services rendered. The access sharing strategy should be similar to that now employed at the University to share the single user PDP-10 system. On the basis of the cost proposal included the Evans & Sutherland access to the facility should be one-half of that available to the University.

SYSTEM DESIGN

The proposed system will have the configuration shown in Fig. 1.

The PDP-11 will be interfaced by the University to the PDP-10 and the ARPA network and the University will be responsible for development of the graphic system software. Evans & Sutherland will use certain components supplied by the University (as specified later) and will deliver the system incorporating this equipment in fully operating condition.

The entire graphics system operates under the control of the PDP-11. The Geometric Processor will include digital processing capability to perform generalized linear transformation (4 x 4 matrix multiplication), perspective transformation, polygon clipping, and the other required operations to place

the information in the Y-Sort Buffer in appropriate form for processing by the Visible Surface Processor. The Visible Surface Processor will be the presently constructed Watkins Processor in use at the University as modified by Evans & Sutherland in order to satisfy the system requirements. The initial shader will also be that now used by the University with a second generation shader to be installed by Evans & Sutherland in 1975. The Frame Buffer will be of new design and permit not only Watkins style operation but will also be directly writeable by the PDP-11 for experimental use with other algorithms. Evans & Sutherland has built and delivered a similar system to the Case Western Reserve University.

It is proposed that a mutually satisfactory detailed specification be developed as a first phase. Evans & Sutherland will assign Dr. Ivan E. Sutherland as its Project Engineer for the proposed system. The detailed specification will be developed by a representative of the University and by David C. Evans and Ivan E. Sutherland. The specification will be approved by both Evans & Sutherland and the University.

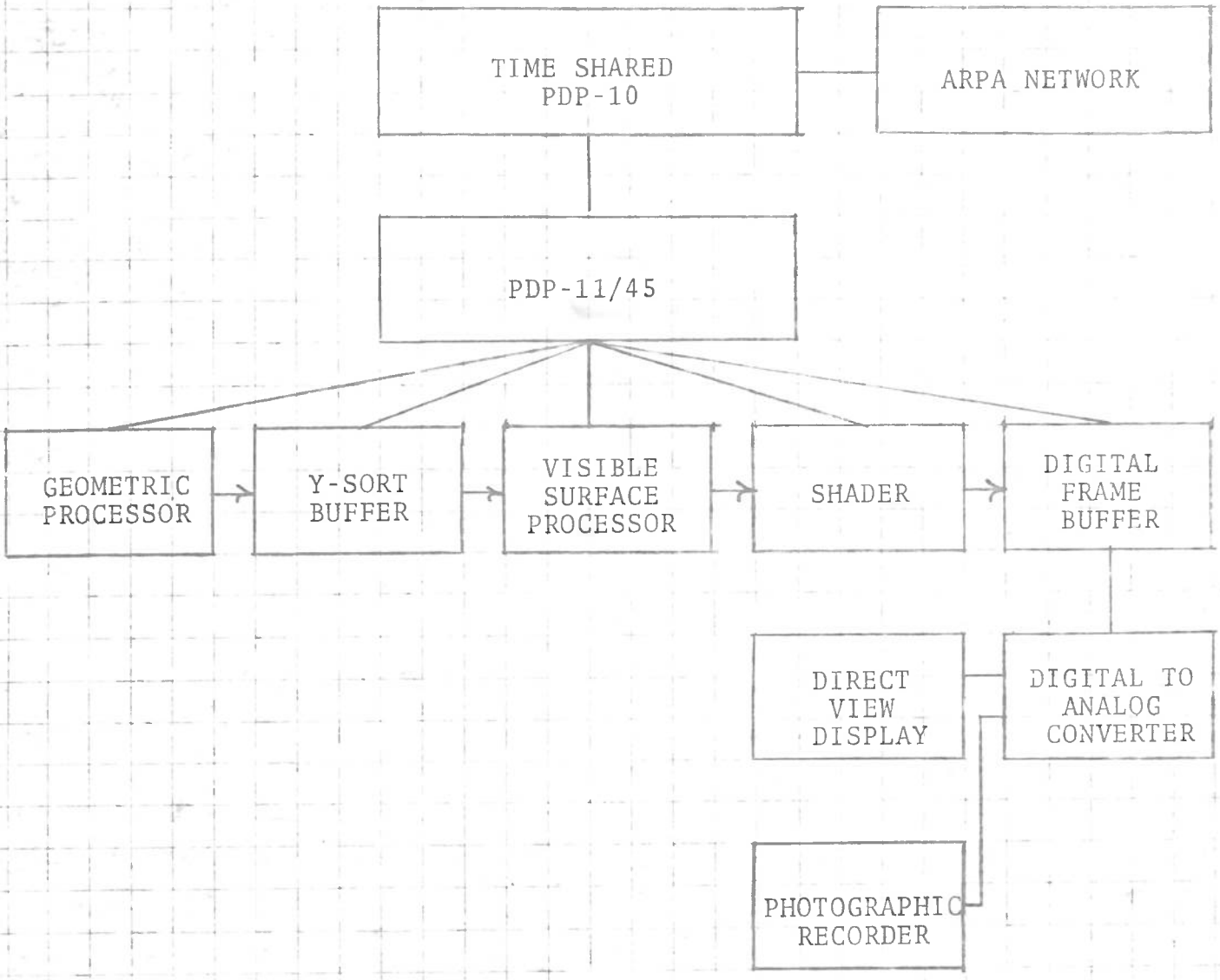

Figure 1. SHADED PICTURE SYSTEM

DURATION OF THE AGREEMENT

The proposed agreement will have duration of two years with the option to extend the agreement at the end of two years if both parties desire. If the agreement is to be extended after two years, written notice must be given by both parties 90 days prior to the completion of the two year period.

In any event, if the agreement is terminated by the University at a time earlier than four years, Evans & Sutherland will retain a continuing right to its use until a total of four years has elapsed. Should the University be unable to continue operation of the equipment to the end of the four year period, the equipment will be made available to Evans & Sutherland for operation by Evans & Sutherland.

SUMMARY OF PROPOSED OBLIGATIONS

Evans & Sutherland

Design, develop, fabricate and deliver the system.

Provide continuing systems engineering services for improvements and modification of the system.

Maintain all equipment for duration of contract.

Provide picture making services on a fee-for-service basis.

Contribute equipment specified in the anticipated cost section.

University of Utah

Provide appropriate space including air conditioning and power for the facility.

Provide existing equipment including:

Real Time Shader

Visible Surfaces Processor

Photographic Exposure Unit

Photographic services on a fee-for-service basis.

Provide graphic support software.

Provide services including:

Facilities management

Systems operation

Clerical service

Payment to Evans & Sutherland for equipment in accordance with the anticipated costs and payment schedule sections herein.

ANTICIPATED COSTS

Estimated Equipment Market Value

	Value of Existing Equipment	FY 74	FY 75
PDP 11/45 with 40K store, floating point unit, 1.2M word disk, magnetic tape.	$	$ 61,040	$
PDP 11/PDP-10 Interface		3,000	
Real-time Shader	5,000	10,000	40,000
Frame Buffer Store		80,000	
VSP	75,000		
Y-Sort Memory		25,000	
Photographic Exposure Unit	30,000		
Other Equipment		20,000	10,000
Polygon Preprocessor (excluding Y-Sort)		75,000	
Y-Sort Processor		30,000	
VSP Remodeling		15,000	
Digiting Tablet		25,000	
Other			14,000
SUB-TOTALS	$110,000	$344,040	$64,000

ANTICIPATED COSTS (Con't.)

Estimated Operating Expense	Value of Existing Equipment	FY 74	FY 75
Principal Investigator		$10,000	$10,550
Facilities Manager		10,000	10,550
Systems Engineer		6,000	6,330
Systems Programmer		19,000	20,000
Maintenance		19,000	26,400
Operation		6,000	11,000
Clerical		4,500	5,000
Supplies, Telephone, Etc.		2,000	2,000
SUB-TOTALS		$76,500	$91,830
TOTAL COST	$110,000	$420,540	$155,830
		TOTAL	$576,370

Distribution of Cost

UNIVERSITY OF UTAH			
Existing Equipment	$ 110,000	$	$
Operating Expense		41,500	48,550
Equipment Purchase from E&S		202,193	55,337
EVANS & SUTHERLAND			
Equipment Contribution		141,847	8,663
Operating Expense		35,000	43,280

DELIVERY SCHEDULE

The equipment designated as FY 74 will be ready for delivery to the designated site at the University of Utah within six months after receipt of order, completion of the detailed specifications and receipt of University of Utah equipment by Evans & Sutherland for update. Some equipment will be delivered immediately as delineated under payment schedule. It is assumed that the site will be properly prepared by the University with air conditioning and power before installation. FY 75 equipment will be delivered by June 10, 1975.

PAYMENT SCHEDULE

It is proposed that progress payments equal to 80 percent of the Estimated Equipment Market Values shown in the Anticipated Costs section of this proposal, be made to Evans & Sutherland upon satisfactory demonstration to the University's representative that the equipment is properly constructed in accordance with good commercial standards and performs the corresponding function as designated in the detailed specifications to be developed. In particular, it is proposed that the PDP-11 and Digitizing Tablet be delivered to the University almost immediately after a purchase order is received. Full payment for the Digitizing Tablet and for the various components of the PDP-11 system will be made to Evans & Sutherland when these

components are delivered to the University. The unpaid 20% of the price for other components scheduled for FY 74 delivery will be made when all of those components are installed and demonstrated to operate as a system. Full payment for the FY 75 components will be made when they are installed and demonstrated by Evans & Sutherland.